length to its hydraulic radius, as clearly support in the Specification. The Office Action asserts that claim 21 is indefinite because it is unclear how the flow channels are formed without a "cover layer." Claim 21 has been amended to provide antecedent basis for the flow passages being connected to a source, such that the flow passages are "comprised of the flow channels." That is, the structured surface provides flow channels that comprise at least part of the flow passages. By these amendments, it is asserted that claims 1-5, 9-10 and 12-24 are not indefinite and Applicants respectfully request withdrawal of the rejection and allowance of the claims.

Rejections under 35 USC 102 and 103

The Specification of the present application makes it clear that the preferred configuration of the microstructured layers of polymeric material is a thin flexible polymeric film. (Page 22, Lines 23-29; Page , Lines 4-8). A film is considered to be a thin, generally flexible sheet of polymeric material. Film has a common industry meaning and is clearly defined in the subject Specification. Use of a polymeric film having a structured surface layer provides numerous advantages, based on the inventors' discovery and expertise as to the ability to microreplicate microchannels by the structured surface into the film layer. The benefits include the ability to make an effective fluid transport device, and in particular a heat exchanger, in a fast, easy and cost effective manner while still providing surprisingly effective fluid flow with extreme accuracy and fidelity of the channel configurations. (Page 9, Lines 7-8).

As such, it is plainly seen that none of the prior art references cited in the Office Action disclose a polymeric film having a structured surface for fluid transport by way of defined microchannels, much less having a cover layer that defines fluid transport channels for heat exchange fluid. Such is set out in independent claim one, which is novel and inventive over the prior art in that no one has even suggested the provision of such microchannels for active fluid transport within a structured surface of a polymeric film layer. The prior art fails to even suggest a desire to do so.

By use of microreplicated thin, flexible polymeric films in accordance with the present invention that have a structured surface including a plurality of microchannels

formed therein, an effective heat exchanger may be economically produced. A cover layer is provided overlying at least a portion of the structured surface to cover at least some of the plurality of microchannels, thereby making a plurality of substantially discrete flow passages. These flow passages are then connected in fluid communication with a manifold that allows a potential to promote fluid movement through the passages to thermally affect the cover layer for promoting heat transfer between the moving fluid and the cover layer. The ability to add additional microstructured polymeric film layers, as well as additional cover layers provides a great deal of versatility to supply heat exchangers for a variety of applications.

The heat exchanger of the present invention is a breakthrough in heat exchanger technology because it utilizes the Applicants' developed microstructured polymeric film innovation in a previously unknown manner. Prior art heat exchangers, including those cited in the references, use commonly known machinable or moldable materials to form flow channels of various sizes. Such heat exchangers are more costly and time consuming to produce, thus making the heat exchanger of the present invention a considerably improvement over the known technology. In this regard, Applicants are not claiming any microchannel heat exchanger, but rather are claiming microchannel heat exchangers that are advantageously formed with a polymeric film layer.

Claims 21-23 were rejected under 35 USC 102(b) as being anticipated by Rosman et al. Rosman teaches an internally manifolded fin plate for a plate/fin-type heat exchanger, which may be formed from a plurality of components. No specific materials or channels dimensions are provided in Rosman, but rather a statement that dimensions and materials to be used will depend on the ultimate use and desired heat transfer rate. (Col. 8, Lines 41-44). By way of example, metals, ceramics and polymers are mentioned. (Col. 8, Lines 44-46). Although Rosman generally provides a method of transferring heat, this reference fails to disclose the step of "providing a heat exchanger comprising a layer of polymeric film material having" a microstructured surface including a plurality of flow channels, as set forth in amended claim 21. Although Rosman mentions polymers, it also states that the disclosed plate/fin-type heat exchanger "will reduce the labor manhours involved in cutting, brazing, welding, leak checking, etc., compared to tube in shell and

plate/fin heat exchangers." These types of statements make it clear that Rosman's heat exchanger is formed from plates of machinable and conventionally fabricated materials. Rosman neither disclose nor suggests heat exchangers formed from microstructured polymeric film layers.

Claim 1 was rejected under 35 USC 103(a) as being unpatentable over Phillips et al. Phillips discloses a method of using a microchannel heat sink formed from ceramics or metals by precision sawing or orientation-dependent etching. (Col. 11, Lines 58-61; Col. 2, Lines 11-13). As stated in the Summary of the Invention, in preferred embodiments, the heat sink is formed from indium phosphide. (Col. 7, Lines 54-55). Regardless of any dimensions for the microchannel heat sink that are disclosed, a heat exchanger formed from a first layer of microstructured polymeric film material is neither taught nor suggested by Phillips. The Phillips device provides nothing more than a microchannel heat exchanger formed of machinable or etchable materials having non of the advantages of the present invention.

Claims 1 and 21-23 were rejected under 35 USC 103(a) as being unpatentable over Bae. Bae teaches a heat exchanger including a plurality of elongated tubes 12 of non-circular cross-section that are preferably made of metal, such as aluminum or copper. (Col. 4, Lines 46-51). A plurality of heat transfer channels 30 in parallel array extend along the minor dimension of tube 12, each channel 30 having a relatively small hydraulic diameter. (Col. 5, Lines 22-24). Tube 12 is formed by bending a relatively flat plate 31 upwardly along an axis and folding a right portion of the plate over the top of a left portion. (Col. 5, Lines 41-45). Representative tube sizes are given as 6-36 inches along a major axis and 1-6 inches along a minor axis. (Col. 6, Lines 12-14). As with the other references cited above, Bae fails to disclose or suggest a heat exchanger formed from a first layer of microstructured polymeric film material.

Claims 1-5 and 9-20 were rejected under 35 USC 103(a) as being unpatentable over Rosman et al. in view of Bae. Neither Rosman nor Bae disclose or suggest the heat exchanger of the present invention formed from a first layer of microstructured polymeric film material. In addition, a hypothetical combination of Rosman and Bae still fails to

disclose or suggest this type of heat exchanger. Nothing in Bae overcomes the deficiencies of Rosman, and likewise, nothing in Rosman overcomes the deficiencies of Bae.

Claims 14 and 24 were rejected under 35 USC 103(a) as being unpatentable over Rosman et al. in view of Bae as applied to claims 1-5 and 9-20, and in further view of Schubert et al. Schubert discloses a method of producing a finely structured body that may be used as a heat exchanger. As described, the structured body includes a plurality of small grooves that are machined into a foil using a shaping diamond. (Col. 1, Lines 55-56). Once the grooves are machined into the foil, the foil may be cut into sections that may then be stacked to form the finely structured body. The focus of Schubert is the ability to machine a large number of channel-like perforations into thin, machinable materials with high precision and high accuracy. (Col. 1, Lines 42-50). As with Rosman and Bae, Schubert neither teaches nor suggests a heat exchanger formed from a first layer of microstructured polymeric film material, and thus nothing in Schubert overcomes the shortcomings of the hypothetical combination of Rosman and Bae.

A number of these cited references discuss heat exchangers having small channels, however, none of them teach nor suggest a heat exchanger formed from a polymeric film layer having a microstructured surface including a plurality of microchannels. The heat exchanger of the present invention overcomes the deficiencies of the prior art, including the cited references, by utilizing an innovative technology that produces microstructured film layers with microchannels in a very fast and inexpensive manner, while achieving extremely high accuracy and fidelity of the channel dimensions and configuration.

Regardless of the specific dimensions for channels disclosed in the prior art, the aspect ratio and hydraulic radius limitations of the amended claims may not be read and applied in isolation. These limitations qualify the previous recitation of a layer of polymeric film material having a structured surface including a plurality of flow channels. It is the provision of a polymeric film layer having microchannels formed therein at the aspect ratio and hydraulic radius values given that is the limitation to be compared with the prior art, along with the remaining recitations of the amended claims. None of the references teach or suggest this combination of limitations within the realm of the heat exchanger art. Therefore,

cited references neither anticipate the presently claimed invention nor render the claims unpatentable. Applicant, therefore, respectfully requests withdrawal of these rejections and allowance of all pending claims.

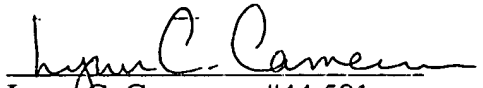
For the reasons provided above, independent claims 1 and 21 are patentable over the cited references. The remaining claims 2-5, 9-10, 12-20 and 22-24 all depend from either claims 1 or 21, and as such, are also patentable for all of the same reasons set forth above. Moreover, each are believed to set forth additional features that further distinguish these claims from the prior art at least in that they combine such features with the allowable features of the independent claims.

CONCLUSION

All pending claims are now in condition for allowance. A notice to that effect is respectfully requested.

Respectfully Submitted,

THOMAS I. INSLEY et al.

By: 

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